The two faint slanting markings, one passing through the centre of the disc (from N.W. to S.E.), and the other to the N. of it and parallel to it, were again seen as on the 11th. Secchi Continent probably occupied all the middle region of the disc; its eastern portion had less warm colour than the rest.

April 23, 9^h. Knobel Sea, dark, extended from the N. polar cap to the centre of the disc. Airy Sea lay to the east of it, and Lassell Sea to the west. The forked bays in Herschel II. Strait were also seen. No warm colour on the disc. The bright Rosse Land not seen. The bright yellow region near the S. pole was probably Jacob Land. The *p* limb was not very bright; it was very bright on the 20th and 21st. On the 24th the same features were seen as on the 23rd.

April 25, 8^h to 9^h. Knobel Sea was near the *f* limb, and the Kaiser Sea lay close to the *p* limb as a dark line. When the Kaiser Sea entered the very bright lune along the *p* limb it disappeared or became very faint indeed. There was a very slight warm (ruddy) colour over the central portion of the disc.

April 26, 8^h and 9^h. The Kaiser Sea lay near the *p* limb and along it; the darkest part of the sea could be seen when quite inside the bright lune, which lay along the *p* limb. Knobel Sea was near the *f* limb. The greenish band of seas and lands to the N. of the S. pole was the only other feature seen. Lockyer Land was seen as a bright yellow region surrounding the S. pole. Later, the forked bays seen, dark; Lassell Sea glimpsed now and then.

April 30, 8^h and 9^h. The Kaiser Sea near the central meridian; its faint and narrow northern portion was near the centre of the disc. This narrow portion was not seen to extend up to the western end of Nasmyth Inlet. Nasmyth Inlet and Lassell Sea not well seen. Delambre Sea and Lockyer Land seen. Flammarion Sea, dark, was seen quite up to the *p* limb. Dawes Ocean extended quite up to the *f* limb without any loss of distinctness or tone.

Lyrids, 1901 *April, observed at Cambridge.*

By J. C. W. Herschel.

1. I watched for the *Lyrid* meteors on April 12 and 17 to 22 to see whether I could trace any motion of the radiant, as suspected by Mr. Denning. I noted down 60 meteors, of which 40 came from the neighbourhood of *Lyra*. Of these I have rejected 6 as not well enough noted to use, and 2 as being too far from the radiant (see § 4). The remaining 32 distribute themselves among six centres, as tabulated below.

Mean Centre. α δ	Ap. 12.	Ap. 17.	Ap. 18.	Ap. 19.	Ap. 20.	Ap. 21.	Ap. 22.	
I. 267·9 + 28·1	...	...	...	...	1	2	...	= 3 ↓'s
II. 273·5 + 27·7	...	...	...	1	2	1	...	= 4
III. 274·5 + 33·6	...	...	...	1	1	1	3	= 6
IV. 278·0 + 37·3	2	1	1	1	4	2	...	= 11
V. 278·1 + 30·8	...	...	...	1	0	3	1	= 5
VI. 281·4 + 32·5	...	...	...	...	1	2	...	= 3

Unfortunately none of these centres furnished enough meteors day by day to give a satisfactory daily determination of the radiant point; the crossing point of two meteors is not enough to build evidence upon; if motion exists, I have not enough data to show it (but see § 8). But, on the other hand, as all the tracks pass within one degree of their assigned radiants—and none have been omitted because they would not fit in—I can fairly treat the radiants as stationary, and on this assumption I find (without weights) the mean centres for the whole period, as given in the first column. The effect of zenith attraction would be less than $\frac{3}{4}^\circ$.

2. With many lines crossing each other at all angles over a small space there are sure to be several points of concentration or apparent radiant points, and it is by no means easy to distinguish the real from the fortuitous. These *Lyrids*, for instance, show more apparent radiant points than the six I finally chose; and it may be of interest if I describe in general terms my method of discrimination.

Perhaps one or two will be so strongly determined as to stand out obviously. Four meteors (or at the least three well noted ones) are necessary for this first step. Such are radiants III. and IV. Eliminating these by making a fresh tracing of the rest will probably eliminate also one or two fortuitous centres, and bring out more clearly weaker radiant points, indicated by short close meteors. Even two only may be enough as an *indication* for the second step. Radiant VI. was found in this way from the 7th and 8th meteors given in table, § 4. For the third step a single meteor is enough if it has been also observed elsewhere (radiant II.); and, finally, a radiant point given by a doubly observed meteor not seen at all by the observer can be taken as an indication (*e.g.* radiant I.). On going through this process for the first time it is very likely that, if any are left, they will seem to be stray single ones, and unassignable; but by repeating the process several times, and reassigning meteors which pass through more than one radiant, and may belong to either, an arrangement will most probably be found to suit them all, with a fair probability of its being the right arrangement.

3. Five of the meteors seen here were observed elsewhere. Professor Herschel has found their real paths and radiant points, and the following particulars of their courses, with notes on two of the paths which were derived from triple observations, are taken from a list of sixteen such real path determinations of meteors seen this year on April 13–21, which he kindly supplied me with.

Date. April.	Statn.	Hour. G.M.T.	Mag.	Dur.	From α	From δ	To α	To δ	Description.	Heights (miles) at Beginning.	Heights (miles) at End.	Length m.	Speed m/s.	Theor. Speed.	Radiant. α δ
19*	S.	12 45½	> 1	0·6	354°	+77°	30°	+73°	wh., no str.	77^{m} over 6^{m}	54^{m} over				
	C.	12 46	1	1·0	212	+64	165	+64	orange, broad str. 1^{s}.	N. of Ramsey, Hunts.	6^{m} NNE. of Oundle, Notts.	32	32	32¼	265° + 24° ± 1½° 19° S. of E. alt. 14½°
	M.	12 45	2	v. quick	258	+11	250	− 3½							
20†	Ba.	10 25	2	...	298	+42	317	+43	...	57^{m} over North	52^{m} over do.				
	C.	10 22	1	1·6	283½	+38½	296	+44	red or yellow	Sea, 2° 44′ E.	2° 20′ E.	32	20	24½	220° − 21° 32° S. of E. alt. 14½°.
	M.	10 21	2	r. slow.	255	+ 7	261	+11½	...	53° 11′ N.	53° 33′ N.				
20	C.	11 36 (used for radiant II.)	♃	1·2	255	+47½	236	+57	wh., str. ½ˢ dirn. well noted.	70^{m} over 4^{m}	49^{m} over 2^{m}	40	33	32	274° + 28° 6° N. of E. alt. 32°.
	M.	11 35	1	r. quick	252	+ 1½	245	− 7½		N.W. of Halesworth, Suffolk.	S. of Mildenhall, Suffolk.				
21	C.	11 35	1	slow.	11	+57	24	+50	length & dirn. approx.	55^{m} over 55^{m}	37^{m} over 48^{m}	34	...	28	241° + 5° 40 S. of E alt. 32½°.
	M.	11 34	2	quick.	300	+42	323	+45	...	E. of Saltburn, Yorks.	E. of Sunderland, Durham.				
21	C.	11 45½	> 1	1·5	210	+64	163	+61½ ±	broad red or yel. str. 1^{s}.	69^{m} over 2^{m}.	56^{m} over 3^{m}.	25	17	33½	272° + 23° 2° S. of E. alt. 32°.
	M.	11 44	3	v.quick	245	+ 1	240	− 3½	...	N.W. of Ely, Camb.	S. of Holme, Hunts.				

I also add, as found by Mr. Denning (used for radiant I.):

Date. April.	Statn.	Hour. G.M.T.	Mag.	Dur.	From α	From δ	To α	To δ	Description.	Heights (miles) at Beginning.	Heights (miles) at End.	Length m.	Speed m/s.	Theor. Speed.	Radiant. α δ
21	B.	10 9	= ♃	1·8	278½	+52	304	+70	slowish, str. 7^{s}.	81^{m} over 5^{m}	51^{m} over 3^{m}	72	40	[30½]	268 + 30.
	M.	10 7	> 1	quick.	200	+ 8	178	− 4	str. 3–4 sec.	S.W. of Stanford, Rutland.	E. of Droitwich, Worcestershire.				

The observers and stations were :—

S. Professor Herschel, at Slough.
B. Mr. Denning, at Bristol.
M. Mr. Brook, at Meltham, near Huddersfield.
Ba. Mr. Holmes, at East Barnet.
C. Mr. Herschel, at Cambridge.

Notes.

* This meteor may have been a Lyrid from about 266° + 26°, the middle point on the Cambridge backward path, between the tolerably broadside intersections with it, about $3\frac{1}{2}$° apart, of the two backward Slough and Meltham paths, at 265° + 27° and 267° + 24°. The latter two paths, directed in *Cepheus* and *Ophiuchus* almost oppositely away from Lyrid points on their path-lines at 266° + 30° and 271° + 30°, diverged with small inclination to each other in their crossing, from a point of concurrence several degrees south of all those places, at 263° + 19°, and in the narrow-based triangle with this acute-angled summit, a point as nearly as possible equidistant from its three sides was taken, at 265° + 24°, as given in the list for the real path's mean radiant-point. Should the Cambridge path's direction, however, as seems more reasonably probable, have been exactly right, the mean radiant, found as above from the two other paths' very broadside intersections with it, would be at about 266° + 26°, more nearly included in the Lyrid radiant area than the supposed point, as given in the table, at 265° + 24°.

† Although the three times of appearance differ rather largely (which recurred, however, similarly in the same lists in other accordance cases), these three path-descriptions all certainly referred to the same meteor, which, appearing in an unusual quarter, E. and N.E., in the Meltham and East Barnet lists, agreed perfectly in those lists in base-line direction and amount of displacement from the Cambridge path. The two best situated paths, at Cambridge and Meltham, to fix the radiant-point gave a backward intersection at 231° − 12°, near β *Libræ*, and of that point's exact correctness there could be no doubt had the East Barnet path conformed to it. Mr. Holmes' observations there were a first experience in meteor mapping, and the mapped track was so far astray in its direction as, when lengthened backwards, to cross the Cambridge path itself about one-third way from its commencement, and, carried further back, it was so nearly parallel to the mapped course at Meltham as not to intersect that track's back-prolongation at any point above the southern sensible horizon. As there is a marked region of active, though not yet well located radiant-points during the April meteor period on the south-western side of *Libra*, although the above intersection point at 231° − 12° is not far from the positions, $234\frac{1}{2}$° − $13\frac{1}{2}$° and 235° − 15°, given in Mr. Denning's General Catalogue and in his list of co-Lyrid meteor-showers (in *Astr. Nachr.* No. 3513) of the notable April shower of η *Librids*, the rather dubiously small angle at which the chief pair of paths converge to it, and the third path's apparent alignment to some more southward radiant-focus, made the presumed radiant-point at 220° − 21° adopted in the list, 14° along the medial direction axis of the Cambridge and Meltham path-lines, backwards from their simple intersection, commend itself for trial and assumption, as several recorded meteor-paths in this and last year's Lyrid watches appeared to diverge very consistently and distinctly from a productive focal centre there, near ι *Libræ*. For a similar reason of a suspected meteor-shower near β *Libræ*, a real path of this meteor, differing but little from the present one, was extracted from its three recorded paths by Mr. Denning, with an adopted radiant-point at 227° − 16°, on the same line of mean direction, but only 7° behind the place of intersection of the two chief backward path-lines noted at Cambridge and Meltham. Those two path-lines both pass backwards within one degree of that assumed position, and within two degrees of the radiant-point position near ι *Libræ* used in this real path's construction.

4. In *Monthly Notices*, 1899 March, vol. lix., p. 333, Mr. Denning says: "In endeavouring to find whether motion occurs in a radiant, only such meteors should be utilised as are well observed, and situated near their radiants. If observers set themselves to accumulate observations of this kind, we should in a few years have the means of disposing of some vexed questions in this branch of observational astronomy."

(I was glad to light upon this opinion, for nearly all my tracks *end* within 45° of *Vega*, this being as large a field as I have found that I can properly watch, and I had to let some half-dozen *Lyrids* go on this account, besides the two mentioned in § 1). Accordingly I give a list of my best observed meteors. I give the places accurately as plotted at the time, but the decimal is of course uncertain. The last column gives the perpendicular on the track from the assigned radiant point as a measure of the accuracy.

Date. April.	Hour. G.M.T.	Mag.	Dur. Sec..	From α	From δ	To α	To δ	Description.	Radi. Assigned. α	Radi. Assigned. δ in
1901	h m									
12	*11 15	2	...	285·4	+32·3	290·5	+27·4	blue.	278·0	+37·3
	*11 30	2	...	288·5	+37·5	295·4	+37·0	,,	,,	,,
17	12 48	> 1	·4	289·6	+31·1	293·6	+28·8	bright blue.	,,	,,
18	11 44	1	·2	281·1	+33·7	282·3	+31·7	,,	,,	,,
19	11 12	1·5	·9	305·2	+33·7	312·6	+31·7	red, on horiz.	,,	,,
	14 43	2	1·0 ±	255·6	+35·4	239·8	+35·7	wh., sl. str.	278·1	+30·8
20	14 15	1	1·1	280·0	+37·5	279·4	+40·0	,, ,,	281·4	+32·5
21	10 52	1	·7	270·7	+36·1	265·4	+37·0	white.	,,	,,
	12 49	1	·6	253·2	+29·6	247·2	+26·8	bright blue.	278·0	+37·3

5. For a first determination of the radiant point without weights I have used a simplification of Schiaparelli's graphic method, for which I am indebted to Mr. H. C. Plummer. Schiaparelli drops perpendiculars on all the tracks from three corners of a square round the assumed radiant. Mr. Plummer uses two points on the axes (and the origin implicitly). Indeed, it is evident that two conditions ought to be enough to find the two coordinates required:

Let $x \cos \alpha + y \sin \alpha - p_0 = 0$ be the equation to a meteor; then

$$\left.\begin{aligned} x\Sigma \cos^2 \alpha + y\Sigma \sin \alpha \cos \alpha - \Sigma p_0 \cos \alpha = 0 \\ x\Sigma \sin \alpha \cos \alpha + y \Sigma \sin^2 \alpha - \Sigma p_0 \sin \alpha = 0 \end{aligned}\right\}$$

give the radiant. Let $(x,y)'$ and $(x,y)''$ be the coordinates of the feet of the perpendiculars on each track from $(0,\lambda)$ and $(\lambda,0)$, where λ is *any* convenient length, and putting

$$\sigma_1 = \Sigma x',\ \sigma_2 = \Sigma x'' \qquad \tau_1 = \Sigma y',\ \tau_2 = \Sigma y'' \qquad n = \text{no. of } \downarrow\text{'s}$$

* Observed at Littlemore, near Oxford, long. 1° 13′ W. lat. 51° 43′ N.

the equations are easily transformed into

$$x(\tau_1-\tau_2)+y(\sigma_2-\sigma_1) \qquad\qquad =\lambda(\sigma_2+\tau_1-n\lambda)$$
$$x(\sigma_1-\sigma_2+n\lambda)+y(\tau_1-\tau_2-n\lambda)=\lambda(\sigma_1-\tau_2)$$

It is often convenient to take one λ, or both, negative: this is equivalent to turning round the axes; it is less confusing to turn round the equations; the appropriate changes are readily found.

6. I have made use of Mr. Cookson's expression (as corrected by Mr. Plummer) (*Monthly Notices*, 1901 January and March), to find the weights. I have left over the probable errors until I have accumulated more observations. The term depending on p_r (the perpendicular from the graphically deduced radiant point, § 5) I have found to be *always* negligible, so that the expression for the weight, g, reduces to

$$g=\frac{\mathrm{D}^2}{\mathrm{P}}$$

simply,* with the curious result that the weight is independent of the accuracy as to direction—the only element used in the graphic method—and I should define the criterion of a meteor's right to be included in the determination of a radiant to be, "when the p term begins to be sensible the meteor's right begins to be doubtful." The weight, then, is a rough measure rather of the *usefulness* of including the meteor than of its *right*. Weighting the equations would alter my radiant points less than half a degree.

7. In a list which Mr. Denning has kindly sent me of Lyrids and others seen by him at Bristol between April 13–24 he has grouped together twenty meteors as Lyrids without assigning a definite radiant point. They form, in fact, just such a group as I start with, and discussing them in the same way as I have mine, I find that the group readily splits up into five radiant points, three of which confirm mine:—

Bristol. α	Bristol. δ	Cambridge. α	Cambridge. δ
267	+30	268	+28
268·5	+32·5		
270	+33		
274	+27	273·5	+28
273·5	+33·5	274·5	+33·5

* D is the length of the meteor-track

$$\mathrm{P}=l^2(\lambda^2+\overline{l+\mathrm{D}}^2)+\overline{l+\mathrm{D}}^2(\lambda^2+l^2)+p_r^2(l^2+\overline{l+\mathrm{D}}^2)$$

in which λ, the radius of projection, or scale of the map, can be put $=$ unity, and l is the distance of the beginning point of the meteor-track from the foot of the perpendicular p_r. This is a slight transformation of Mr. Cookson's formula, which I have found more easy to use in practice. P, as a whole, is identically the same, and $p_r^2(l^2+\overline{l+\mathrm{D}}^2)$ is the negligible term.

The two distant meteors I have rejected, and one which I have assigned to Radiant III. may have come from 270+33. Mr. Denning's meteors were mostly on the 21st; there are not enough on other days to prove motion of the radiant.

8. Radiant IV. is probably quite a distinct stream from the true Lyrids (see Denning's Catalogue). Its characteristic bright blue meteors (§ 4) like Roman candles are in strong contrast to the red broad-streaked Lyrids. As to the others (though one must be cautious in drawing deductions from so few meteors), they show no tendency to sequence of appearance in time, *i.e.* to one radiant in motion, but rather contemporaneous activity; and, further, they occupy an area about 10° by 5°, whose length lies much in the same direction as the suspected motion. May not an area of such a shape give the impression of a radiant in motion, and yet really contain stationary radiant points with perhaps variable activity? The shape also suggests some spreading action *in process*, such as Professor Turner suggests as an explanation of stationary radiants; but if so, I do not see how it can be due to the Earth, as it is not parallel to the ecliptic, but to the Milky Way.

Corrections to reduce the Revised Madras Catalogue of Stars for 1835·0 *to the Fundamental Catalogue of Auwers* (*Pub. Ast. Gesell.* xiv. and xvii.). By A. M. W. Downing, M.A., D.Sc., F.R.S.

In the recently issued edition of Taylor's Madras Catalogue for 1835 the clock errors were determined from the right ascensions of standard stars in Auwers' Fundamental Catalogue (*Pub. Ast. Gesell.* Nos. xiv. and xvii.), whilst the index errors were determined from the declinations of the same catalogue corrected so as to represent Auwers' Mean System (*Ast. Nach.* No. 1536).

It may be of interest to give here the corrections applicable to the places of the Revised Madras Catalogue to reduce them to the system of Auwers given in *Pub. Ast. Gesell.* Nos. xiv. and xvii.

It should be noted that the mean $\Delta\alpha$ is $+^{s}{\cdot}015$ from 402 stars, and the mean $\Delta\delta$ is $-0''{\cdot}44$ from 297 stars.

The limits of declination for $\Delta\alpha$ and $\Delta\delta$ are determined by the limits adopted for the stars used for clock error and index error respectively.